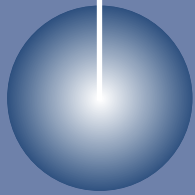


Geothermal *technologies*



DOE Geothermal Technologies Program Website Redesigned

The DOE Geothermal Technologies Program website (www.eere.energy.gov/geothermal) has been redesigned and updated. It conveys information about the new program organization and structure, and provides more links to helpful information for consumers, students, and educators. It also now includes links to program review and presentation material from the last five years. The GeoPowering the West initiative was included in this redesign, and can now be found under the heading, "Deployment."

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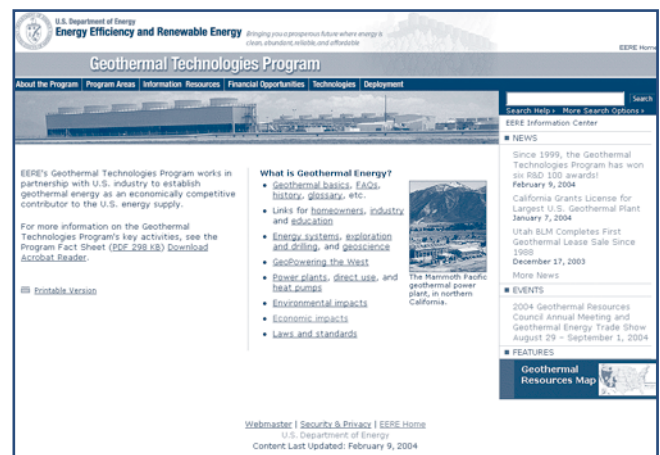
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An impetus to redesigning the website came from EERE's new Communication Standards and Guidelines, specifically, the Web Guidelines. You will see more of this "branding" and common "look and feel" to EERE's communication products during the coming year.

Any users bookmarking or linked to the former program Web address (www.eren.doe.gov/geothermal) will automatically be "redirected" to the new website.

Contact Bruce Green, National Renewable Energy Laboratory, (303) 275-3621, or e-mail at: bruce_green@nrel.gov.



U.S. Geothermal Tests Production Wells at Raft Energy Project

U.S. Geothermal Inc., a renewable energy development company focused on geothermal energy in the Pacific Northwest, has begun a workover and flow test program on five existing energy production wells at Idaho's Raft River Geothermal Project.

The testing uses funds from a \$396,000 DOE Geothermal Resource Exploration and Definition Grant. When the company opened the wells this past spring "we had an immediate response in pressure and flow," which confirmed the wells' capacity, said Daniel Kunz, president of Idaho-based U.S. Geothermal.

The production wells being tested produced artisan flow of 250 to 600 gallons-a-minute, and maintained wellhead pressures of 140 to 170 pounds per-square-inch. Fluid production temperatures from individual wells historically range from 270°F to 295°F (135°C to 149°C).

(continued on page 2)



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable



Preparing to remove blind flange from top of well #5.

Well flow testing is expected to last one to two months. Data collected from the tests will help the developer design a binary cycle power plant.

An early Raft River assessment suggests the total geothermal resource could produce around 90 MW (net) of electricity. The five existing production wells could generate 14 to 17 MW (net).

Geothermal energy generates electricity in several western states, although not currently in Idaho. The Raft River, in Cassia County in south-central Idaho, is the only area in the state where geothermal resources have generated power. That took place in the 1970s, when DOE invested \$40 million to build a demonstration plant, five production wells, two injection wells, and seven monitoring wells.

The result was the world's first geothermal binary cycle power plant, a 7 MW dual flash system, which was designed, built, and tested in 1979. The plant produced electricity for only a few months on a test basis. But the technology has since advanced to become a leading, proven method for producing electrical power from moderate-temperature geothermal resources.



#5 wellhead with spool and blow out preventer in foreground.



A steam release from the RRG-1 production well at Raft River.

Currently, 12 binary cycle plants operate in the western United States, and produce around 184 MW of electrical power.

The Raft River site is attractive because of the proven 300°F wet steam resource, and because of the facilities that remain from the 1979 DOE demonstration project.

Existing well field investments include five deep (4,925 to 6,542 feet), large-diameter geothermal production wells along with well site pads; two moderate-depth (3,800 to 3,900 feet) geothermal injection wells; and seven groundwater monitoring wells. Other assets include an office/control room building, a shop with 15-ton overhead crane, a 300,000 gallon water/fire tank, warehouse, lined ponds, roads, fences, and current state of Idaho geothermal permits.

A 138-kilovolt transmission line also crosses the site with a total transmission capacity of 120 MW. A local electrical cooperative owns the line, which connects the site to the northwest power grid. U.S. Geothermal said it has discussed its development project with the cooperative and has been told excess transmission line capacity is available. A half-mile-long connecting line and step-up transformer will be needed.

The Raft River Valley is a Cenozoic basin bounded on the east by the Black Pine Mountains and the Sublett Range, on the west by the Jim Sage and Cotterel Mountains, and on the south by the Raft River Range. One likely source of the hot water supplying the geothermal reservoir is rain and snow that falls on the surrounding mountain ranges. This water circulates down to the hot, fractured basement rock underlying the Raft River Basin's sedimentary formation. A second water source is believed to originate from a 3- to 5-kilometer-deep circulation system, which migrates upward to the base of the valley basin fill where it moves into the fracture-dominated reservoir.

Blue Mountain Project Successfully

Completes Second Test Wall



Boart Longyear Coring Rig, Deep Blue #2 well.

The second stratigraphic test well, DB-2, drilled at the Blue Mountain Geothermal Project 30 kilometers (20 miles) west of Winnemucca, Nevada, was successfully completed on April 29, 2004. The hole was drilled under a cost sharing agreement between Noramex Corp. and the U.S. Department of Energy under the Geothermal Resource Exploration and Definition (GRED II) program to explore the geothermal resource to the west of Blue Mountain in an area previously explored for gold.

Noramex drilled DB-1, the first deep stratigraphic test well, to 672 meters (2205 feet) in 2002. DB-1 intersected economic temperatures of 145°C (292.5°F) at a depth of 645 m (2115 ft). DB-1 had lost circulation and indications from the temperature survey of high permeability in the almost 366 m (1200 ft) of hole with high temperatures.

DB-2 encountered higher temperatures, 167°C (333°F) at 585 m (1920 ft), also with good indication of permeability from lost circulation and from the temperature surveys from 201.17 m (660 ft) to bottom.

Both wells were drilled with close cooperation and assistance from Sandia National Laboratories. The first well tested the resource along a major north-south trending fault. DB-1 was planned with 7" casing cemented to a depth of 120 m (400 ft) and 4 ½" casing cemented to a nominal depth of 250 m (820 ft). Dynatec Drilling Inc. drilled the hole using a Universal Drill Rig 1500, which is capable of drilling both the rotary and core sections. The upper part of the hole in the cased intervals was planned for rotary drilling and cementing by the displacement method.

Massive zones of lost drilling circulation required constant remedial work and attention in the upper part of DB-1. A major loss of circulation occurred during rotary drilling of the 9 ⅞" hole for the 7" casing, at a depth of about 84 m (276 ft), that was cured with cottonseed hull LCM and finally a cement plug. Thereafter, lost circulation was a continuous problem. At a depth of 99 m (325 ft) circulation was totally lost and could not be regained. Alternative lost circulation materials were tried and five cement plugs with coarse material (gravel, briquettes) placed in the well to hold the cement from flowing into formation voids. The 7" casing hole was successfully completed past the severe loss zone to 105 m (345 ft), but unfortunately, on placing the 7" casing, it hung up in the trouble zone at 97 m (321 feet) and had to be set at that depth. Lost circulation problems continued in rotary drilling of the 6 ¼" hole for the 4" casing. A decision was taken to switch to large-diameter (12.26 cm, 4.83-inch) PQ coring at a depth of 112 m (367 ft), and the hole was advanced into more competent rock. In order to expedite drilling, 4 ½" casing was set earlier than originally planned, at 175 m (573 ft), and subsequently, the HQ-coring interval proceeded with relative ease to 579 m (2205 ft).

Cementing for DB-1 casing was compromised by the severe loss zone at the casing shoe for the 7" casing and by the small annular space for the 4 ½" casing. Shallow, hot fluid is migrating down behind the 4 ½" casing from a zone near the bottom of the 7" casing indicating that a complete cement bond was not achieved.



Dynatec Drilling Inc.'s drill rig Deep Blue #1 in 2002.

For DB-2, a flooded reverse circulation technique for drilling an oversize hole for the casing segment to 200 m (660 ft) was planned in an effort to overcome circulation problems in highly fractured ground. Below the cemented casing at 200 m, the hole was to be HQ cored to total depth of 1000 m (3281 ft) using a different drill rig.

(continued on page 4)



Flow test for Deep Blue #2 with Boart Longyear Company in 2004.

In flooded reverse circulation drilling, dual wall drill pipe is employed that allows circulation fluid to be pumped down the inner annulus returning up the center of the pipe. A larger hole (9 $\frac{7}{8}$ ") than normally needed was drilled so that the 4 $\frac{1}{2}$ " casing could be cemented from the top with tremmie pipe, enabling cementing to be accomplished despite losses. Normally, so long as the tools behind the bit are submerged, the hole can be advanced through loss zones. Losses would be cured with LCM if possible and then cemented in the open hole-section with low temperatures to reduce the risk of cool water zones flowing downward into the deeper, higher temperature zones.

Total lost circulation was encountered in two zones in the cased portion of the hole that was then drilled blind from 561.75 m (1843 ft) to the bottom of the hole. No cement plugs were placed in the top hole. As well, the use of top down cementing of the 4 $\frac{1}{2}$ " cas-

ing ensured a better cement job despite losses in drilling the 9 $\frac{7}{8}$ " hole. In the open hole-section, loss zones were controlled with the use of LCM cottonseed hulls and by setting a cement plug over one interval below the casing. This plan was very successful, and smooth progress allowed DB-2 to be drilled to a depth of 1128 m (3700 ft) or 11% deeper than originally planned.

Noramex Corp. is pleased that both DB-1 and DB-2 were drilled to their intended targets, each providing very encouraging results for further work at the site. The success of the program is directly attributable to high-quality work and technical support provided by drill contractors and the excellent work of administrative managers and technical experts at Sandia National Laboratories. In particular, Noramex would like to acknowledge the contributions of Larry Pisto (Dynatec Drilling Inc.), Roger Magee (Boart Longyear Company), Allan Sattler, Dan Sanchez, Norm Warpinski, Chip Mansure, and Stephen Bauer of Sandia National Laboratories.

Contact Allan Sattler, Sandia National Laboratories, (505) 844-1019 (phone) or e-mail at: arsattl@sandia.gov.

New Sandia Geothermal Program Manager

After several years of managing Sandia National Laboratories' geothermal program, Ed Hoover was tapped on very short notice to head up a strategic development activity in our defense programs area (Sandia's primary mission). At the same time, Craig Tyner was looking for a new assignment after heading various elements of our solar programs for the past 15 years. Craig's experience managing DOE renewables programs along with previous geotechnology experience (in-situ oil shale and coal gasification) made him an obvious match and allowed the Sandia geothermal program to make the transition with minimal disruption. You can reach Craig at:

Geothermal Research Department 6211

Sandia National Laboratories, MS 1033

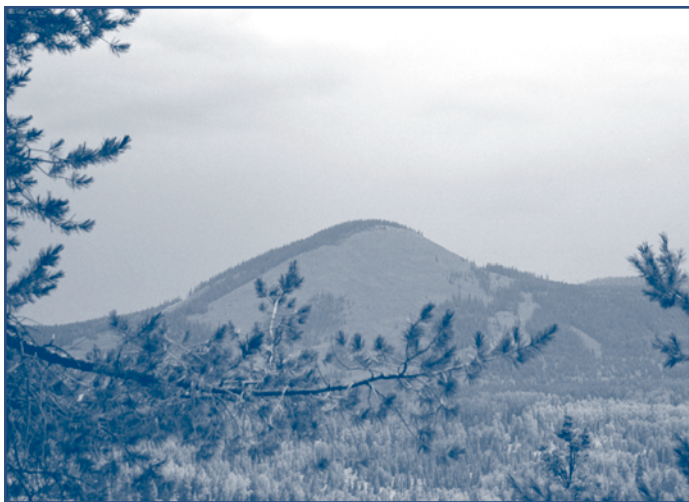
Albuquerque, NM 87185

Phone: 1-505-844-3340; Fax 1-505-844-3952

E-mail: cetyner@sandia.gov

GeoPowering the West – New Mexico

State Working Group Meets



Valles Caldera dome.

A regular meeting of the New Mexico Geothermal Energy Working Group was held on May 12 in Santa Fe, New Mexico. A group was formed to work on the two awards that New Mexico received from the DOE State Energy Program. New Mexico is responsible for developing a geothermal information clearinghouse and direct-use development reports. Volunteers were identified, and a meeting will be held in Las Cruces on June 15 and 16.

Ken Boren of Geothermal Products of New Mexico described attempts to develop the Valles Caldera project in northern New Mexico. This project has received a lot of adverse publicity in the past because of its location in the Valles Caldera National Preserve, and the environmental community has stated opposition



Previous plant site at Valles Caldera with retaining wall.

to it. At the meeting, one environmentalist listed criteria that may be helpful in determining the support for projects in general, but will be particularly important to the Valles Caldera Project. Renewable energy is important in general to reduce pollution, reduce dependency on conventional and often imported energy, and to mitigate climate change. For support of any particular projects, however, it was stated that public support is needed, the technology must be viable, and environmental standards must be met. It is this latter item that is contentious for the Valles Caldera project. However, interactions at the state working group were quite cordial, and this meeting was a good forum for discussions.

Contact Roger Hill, GPW Technical Director, (505) 844-6111 (phone), or e-mail at: rrhill@sandia.gov.

GeoPowering the West Supports

the California Energy Commission

The California Energy Commission (CEC) held a public meeting in Sacramento May 20 to provide a basis to create a California Geothermal Collaborative to mobilize the network of geothermal energy stakeholders in California to:

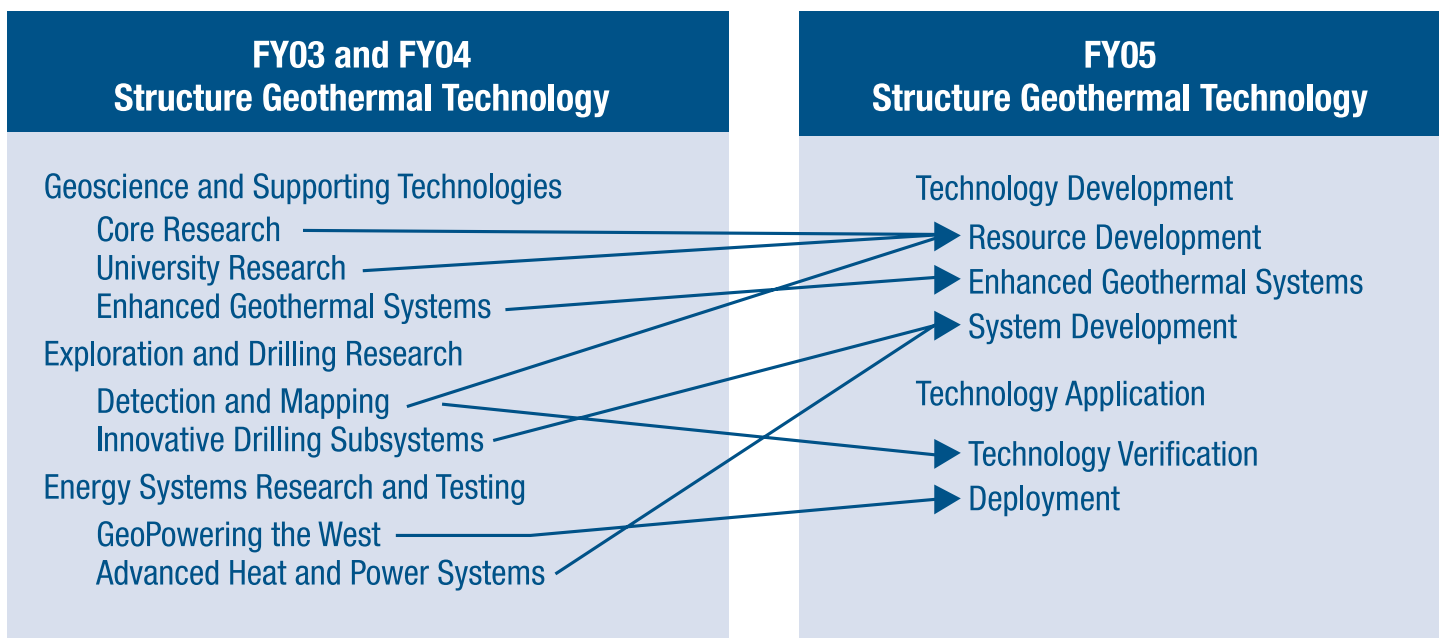
- Meet renewable portfolio standards goals
- Address industry and tribal needs
- Create sustained economic and environmental benefits to California.

There were approximately 90 people in attendance, including major developer/producers and interested Native Americans. There were excellent presentations by Roy Mink, Commissioner John Geesman, numerous California entities, Geothermal Resources Council, and the Geothermal Energy Association. There was a strong and excited expression of interest by attendees in the formation and subsequent activities of a California Geothermal Collaborative. CEC plans to invest \$400k to start the collaborative. DOE GPW individuals assisted the planning and facilitation of the meeting.

Contact Roger Hill, GPW Technical Director, (505) 844-6111 (phone), or e-mail at: rrhill@sandia.gov.

DOE Geothermal Technologies Program

– New Organization for 2005



The DOE Geothermal Technologies Program is moving to a new structure beginning in FY 2005. This fiscal year (2004) is a transition year for which funds have been appropriated in the old structure, but the program is organizing its operations for the structure to be used in FY05. The new structure organizes program activities into two areas: Technology Development and Technology Application. Previous activity areas map over to the new organization as shown above.

Technology Development

Resource Development

Resource Development deals with finding, characterizing, and assessing the geothermal resource through understanding the formation and evolution of geothermal systems. This activity subsumes portions of the former subactivities of Core Research, University Research, and Detection and Mapping. The work builds on continuing research that investigates seismicity, isotope geochemistry, 3-D magnetotellurics, and remote sensing as exploration tools. Available exploration technology from related industries (e.g., petroleum, mining, and waste management) is evaluated for adaptation to geothermal environments.

During the coming year, the Program will develop a suite of improved remote sensing, geophysical, and geochemical techniques and test them in collaboration

with industry as reliable means to locate hidden geothermal resources. Cost-shared investigations of promising new sites will be conducted to verify the presence of resources. The Program will continue to collaborate with the U.S. Geological Survey on a national geothermal resource assessment.

Enhanced Geothermal Systems

Enhanced Geothermal Systems (EGS) includes portions of the former subactivities of Core Research and University Research, as well as previous EGS activities. EGS are engineered reservoirs created to produce energy from geothermal resources deficient in economical amounts of water and/or permeability. EGS technology will increase the productivity and lifetime of those reservoirs. DOE estimates that the application of EGS technology can more than double the amount of viable geothermal resources in the West.

Now and during the coming year, the Program will conduct the following major activities: long-term flow testing of the enhanced reservoir at the Coso Hot Springs geothermal field on the U.S. Naval Weapons Air Station (China Lake, California); preliminary flow testing of the reservoir enhanced at Desert Peak, Nevada; and evaluation of wellbore stimulation experiments. The Program will conduct analyses of flow tests at The Geysers and perform chemical stimulation of a well at Glass Mountain

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Geothermal Systems Research and Development Grant Projects

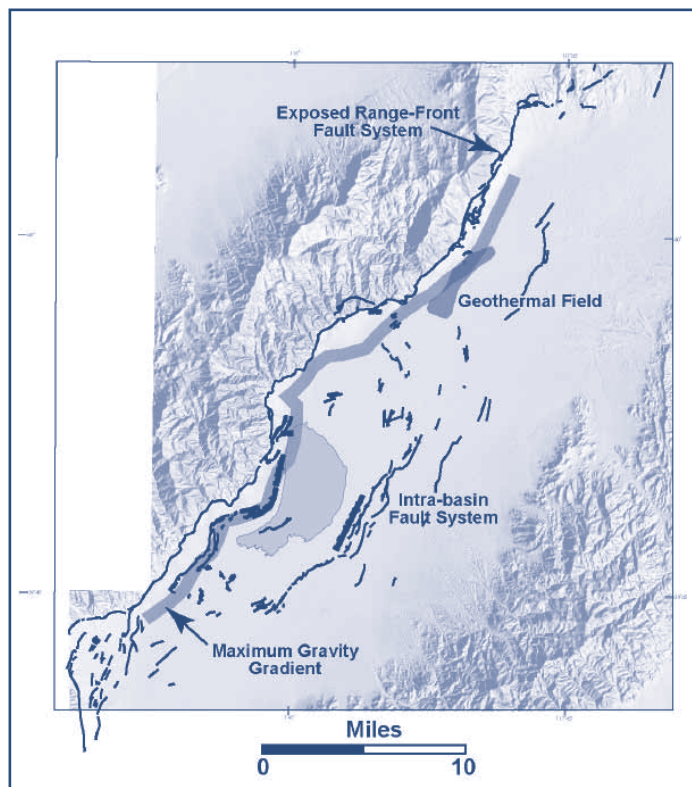
Applicant Name	Budget Information			
	Cost Share	Applicant	DOE	Total
Duke (Malin)	36%	\$96,446	\$170,384	\$266,830
Pennsylvania State University (Elsworth)	21%	\$125,358	\$476,195	\$601,553
SAIC (Pritchett)	25%	\$150,000	\$458,732	\$608,732
University of Utah (Hulen)	34%	\$250,000	\$495,742	\$745,742
University of North Carolina (Rial)	22%	\$134,828	\$487,302	\$622,130
University of Utah (Moore)	27%	\$185,000	\$500,000	\$685,000
University of Utah (Moore)	31%	\$214,999	\$475,599	\$690,598
University of California, San Diego (Möller-Weare)	20%	\$124,804	\$498,646	\$623,450
Pinnacle Technologies (Weijers)	25%	\$96,109	\$288,326	\$384,435
University of Utah (Wannamaker)	34%	\$254,364	\$499,328	\$753,692
University of Utah (Hulen)	29%	\$201,422	\$499,402	\$700,824
University of Utah (Rose)	20%	\$124,979	\$499,986	\$624,965

The EGS program just selected the above (see table) following research projects for funding under Enhanced (Engineered) Geothermal Systems Research and Development Grant (solicitation No. DE-PS36-04GO94001).

Systems Development

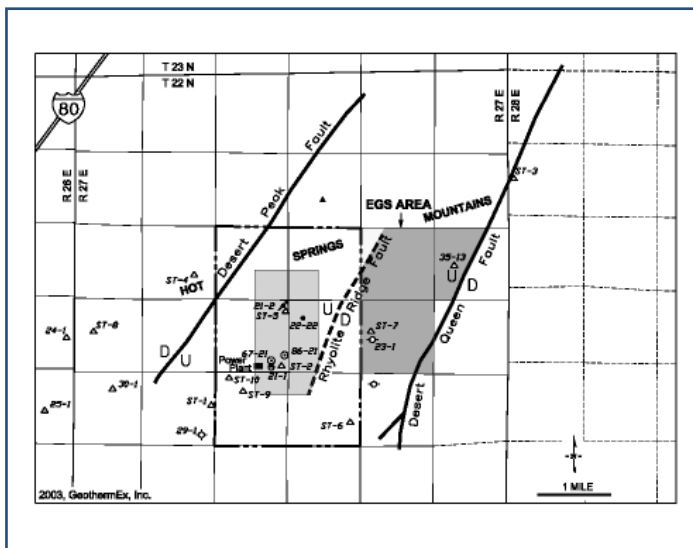
Systems Development subsumes the former subactivities of Innovative Drilling Subsystems and Advanced Heat and Power Systems. Drilling research aims to produce new technologies for reducing the cost of geothermal wells through an integrated systems approach that focuses on improvements to key subsystems. During the coming year, the Program will demonstrate a robust Diagnostics-While-Drilling (DWD) subsystem in geothermal wells, including a high-speed data link, a downhole instrumented sub-assembly for controlling a drag-cutter drill bit, and a software package to assist the driller in controlling the drilling operation.

Advanced Heat and Power R&D focuses on reducing investment, enhancing efficiency, reducing operations and maintenance costs, and increasing revenue via sale of valuable by-products. Advanced Heat and Power Systems also focuses on improved energy conversion



Gravity survey of Dixie Valley.

(continued on page 8)



Desert Peak well locations and EGS area.

technologies including better heat exchangers and condensers. This area also includes definition of innovative equipment, conversion cycle improvements, advanced conversion cycles, better instrumentation and control, silica scale inhibition, and nondestructive testing techniques.

Technology Application

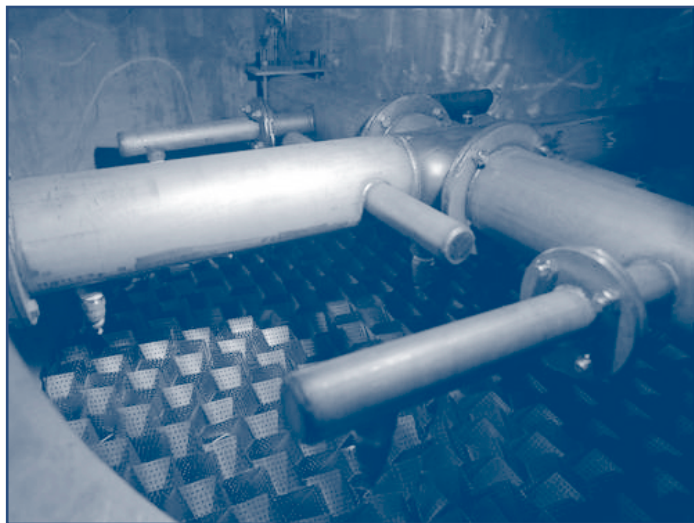
Technology Verification

Technology Verification subsumes a portion of the former key subactivity of Detection and Mapping, and includes cost-shared projects and deployment of near-commercial research products, small-scale field verification, and the latest announcement on geothermal electrical power system validation. Technology Verification moves technologies from research and development to a level where the technologies are accepted and actively used and applied by the U.S. geothermal industry and other stakeholders. All development components of exploration, EGS, drilling, and energy conversion should eventually be field tested to demonstrate improvements in technology performance at a commercial scale.

The Program will collaborate with 10 new industry partners chosen from a recent competitive solicitation to find and evaluate new geothermal resources using DOE-sponsored technology improvements. The program will also test innovative energy conversion technology with an industry partner at a new power plant.

Technology Deployment

Technology Deployment, which includes the GeoPowering the West Initiative, addresses the factors affecting the deployment of geothermal systems, such as complex regulations that can stymie the transition from a prototype to a commercial product. The Program will conduct outreach activities focused on key state and regional development issues. In addition, analytical work will continue on the performance and economics of geothermal systems.



Direct contact condenser packing material at The Geysers power plant in California.

How to Reach Us

For more information contact:
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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.